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ABSTRACT

In the late 1980s an American newspaper reported that by one measure--the number of patents cited by successive inventors--Japan overtook the United States in the number of inventions produced during the 1970s. The reasons for this are not clear, but educational efforts promoting creative behaviors in school children are probably essential and should not be neglected. This document describes two examples of these efforts: (1) the Contest of School Children's Invention and (2) activities in the Invention Clubs for Boys and Girls. The Contest of School Children's Inventions is for primary, middle, and high school students. The Imperial Prize (top honors) was given to primary school students in 1986, 1987, and 1988. The inventions of the Imperial Prize winners for these years are described in detail and a chart listing all the grand prizes from 1986 through 1989 is also provided. The first invention club was opened in 1974 to foster the potential creativity originally possessed by youngsters, to stimulate their imagination, and to help them develop a scientific idea. The largest club (1500 members) is the Kariya Invention Club for Boys situated in the Toyota Science Research Institute. There are 101 clubs in Japan and they cater mainly to students in the third grade of primary school through second grade in middle school. (PR)

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Promotion of School Children's Invention in Japan

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Promotion of School Children's Invention in Japan

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I. Imitator or Inventor

Recently an American newspaper reported that by one measure, Japan overtook the USA in inventions in the 1970s. This measure was the number of patents cited by successive inventors. Japanese patents were cited more frequently than American patents. Now the image of Japan has changed from that of imitator for enhanced creativity to inventor in terms of patent citation The underlying reasons are not clear yet, but educational efforts for promoting creative behaviors in school children are probably essential and should not be neglected. The Contest on School Children's Invention and activities in the Invention Clubs for Boys and Girls are good examples of these efforts.

II. Contests on School Children's Inventions

The Exhibition of the Contests on School Children's Inventions has been held in Tokyo each year since 1941. It is a collaborative effort of the Japan Institute of Invention and Innovation and the Mainichi Shimbun.

Table 1 shows the number of products submitted, according to school level, for the four year period beginning in 1986.

Table 1 Number of Products Submitted According to the School Level

	Total	Primary	Middle	High
1989	811	562	241	8
1988	809	559	241	9
1987	741	505	218	18
1986	800	544	248	8

The Exhibition of the 47th Contests was held in March 1989. This year, 811 products were submitted to the exhibition headquarters from all over Japan. Among them, one received the Imperial Prize, 13 products were awarded Grand Prizes, one received the WIPO Prize, 20 were given

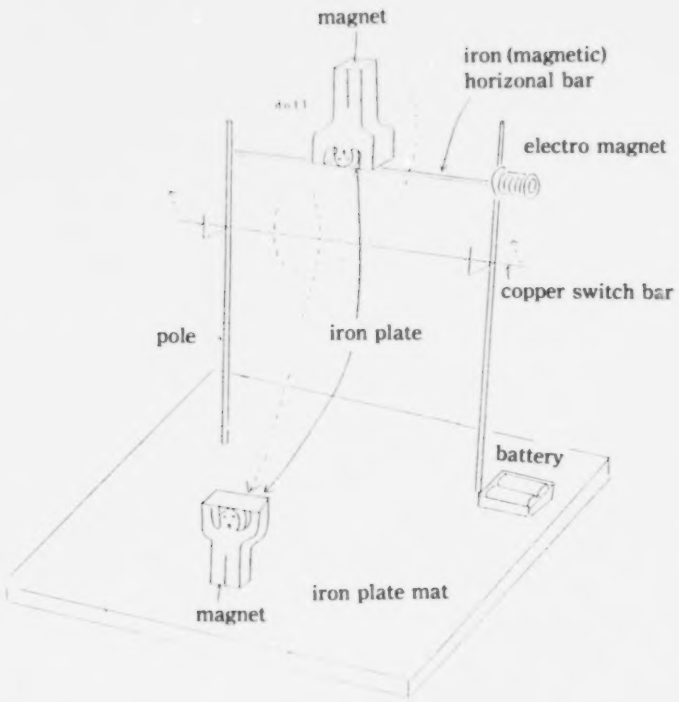


Fig. 1 The Main Structure of "Ultra C Movement, Nice Landing"

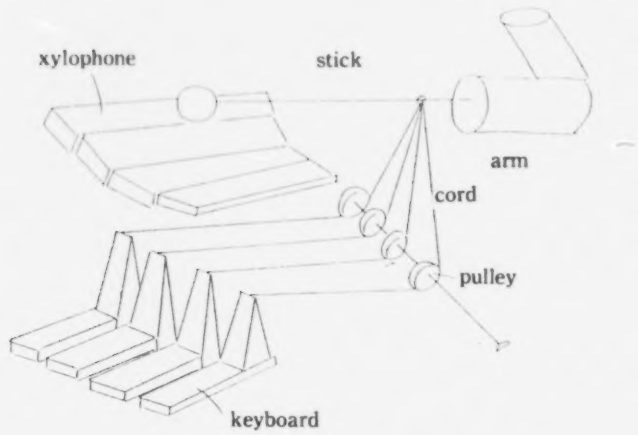


Fig. 2 The Main Structure of "Moppin"

1st prizes and 129 were awarded 2nd prizes. The product awarded the Imperial Prize in 1989 was "Ultra-C Movement, Nice Landing" and was invented by three fifth grade primary school boys. The one in 1988 was Playing Robot, "Moppin" and was created by a fourth grade primary school girl. The one in 1987 was "Linear Merry-go-round", the work of a 3rd grade primary school girl and the one in 1986 was "Fireworks of the River Nagara", created by a 3rd grade primary school girl.

In the "Ultra-C Movement, Nice Landing" as shown in Figure 1, a handstanding doll player made of foamed styrol is set on a magnetic horizontal bar. As the doll is let go, it swings around the bar and cuts off a switch bar, so that it flies off the horizontal bar and, after making a somersault, safely lands on an iron plate mat by virtue of the magnetic attraction between a magnet on the sole and the iron plate mat. Whether or not the doll can successfully turn and land depends on the timing at which an electro-magnet on the horizontal bar is de-energized. When the doll has landed skillfully, 10.00 is displayed on a score board and a national flag is raised by the player's hands. The inventors were deeply impressed by the exquisite skill in horizontal bar gymnastics shown by two Japanese senior high school students in the Seoul Olympic Games and created this product.

Playing Robot "Moppin" in 1988 as shown in Figure 2 is a work wherein a xylophone which can use a scale is formed into a pianolike shape. A doll having sticks in its hands automatically plays the xylophone when a keyboard is pressed because the sticks held by the doll and the keyboard located beneath the xylophone are linked by cords. In order to enable the two sticks held by the doll to strike all of the bars of the xylophone, pulleys are employed at intermediate positions on the cords to adjust the cords. Furthermore, the bars of the xylophone are arranged to produce a waveform so that the sticks strike each bar of the xylophone at right angles. As a result, a xylophone can be played in a manner similar to the way we play a piano. This instrument is named

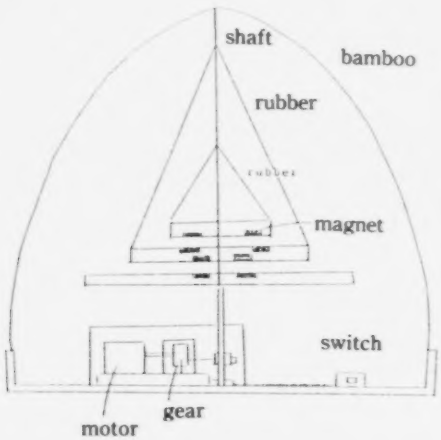


Fig. 3 The Main Structure of "Linear Merry-go-round"

"Moppin" (the Japanese word "mokkin" which means a xylophone and the word "piano" are combined).

"Linear Merry-go-round" in 1987 as shown in Figure 3 has been devised from the memories of the

happy merry-go-round that the inventor enjoyed in an amusement park, and utilizes the force of repulsion of a magnet and the resiliency of rubber. The work includes three circular discs and the lowermost disc is rotated by switching on the motor. Simultaneously, the remaining two upper discs are floated by the repulsion force of an incorporated magnet, and thus rubber members carrying the two discs are twisted to warp around a shaft. When the rubber members are fully twisted, the two discs start to rotate in the opposite direction to that of the rotation of the lowermost disc. Since the rubber members carrying the upper two discs differ in length, they start to rotate in the opposite directions with a time lag between the two, so that each of the three discs is rotated in a different manner.

"Fireworks of the River Nagara" in 1986 reproduces the shoot-up of fireworks. A ball in the center of the fireworks is set in a clip and, as the ball is released from the clip, the fireworks develop with a boom sound.

The WIPO (World Intellectual Property Organization) is a special organization of the United Nations, which was established vith a view to furthering worldwide protection of intellectual property. The WIPO Prize in 1989 was awarded to "Air Coaster" a creation of a fourth grade primary school boy. The one in 1988 was awarded to "Atlas of the World" produced by a 3rd grade middle school boy.

Table 2 shows the list of Grand Prizes for the past four years.

The selection committee consists of university professsors, ministry officials, patent office representatives, industrial designers, and others. Every product is rated for creative idea and novelty irrelevant to previous patent.

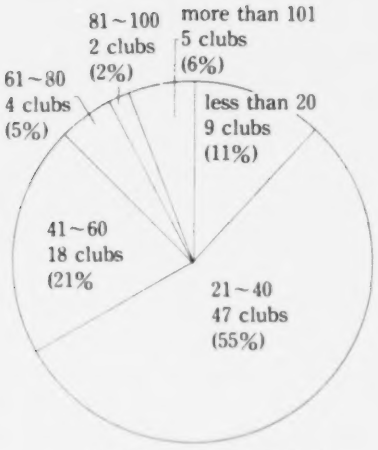
Prince and Princes Hitachi, the Ministers and other high officials attend the Awards Ceremony and boys and girls who have produced excellent work are awarded the Imperial Prize, Grand Prizes and the WIPO Prize after they have described their products to the distinguished participants in the exhibition.

The exhibition aims to arouse children's interest in invention and to motivate their inventiveness.

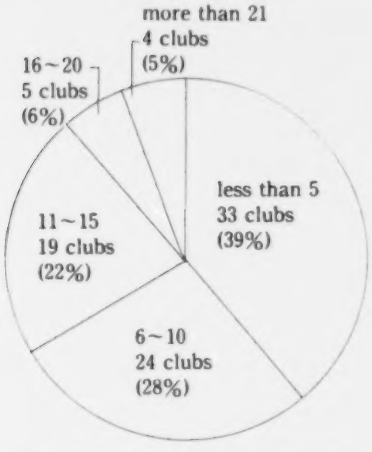
Table 2 The List of Grand Prizes for The Past Three Years

Prize	1989	1988	1987	1986
The Prize of the Prime Minister	Scarecrow Using Color Energy (M3 Boys)	Dreamy Swing (P4 Girl)	Slalom Robot (M2 Boy)	Toilet Paper Case (P3 Boy)
The Encouragement Prize of the Minister of Education	Composing and Playing Music Box (P6 Girl)	"Momotaro" (Peach Boy) (P2 Boy)	Aquarium (P2 Girl)	Monkey Seismometer (P6 Boy)
The Prize of the Minister of International Trade and Industries	Automatic Goldfish Feeder (P5 Boy)	Melon Drill (M1 Boys)	Rehabilitation Machine for Hand (P6 Boy)	———
The Encouragement Prize of the Minister of State for Science and Technology	Device for Creating Music from Nature (P5 Girls)	Flying Trapeze (P5 Boy)	Door which can Be Used as both Sliding and Hinged Doors (P5 boy)	Ramdom Motion (P5 Boy)

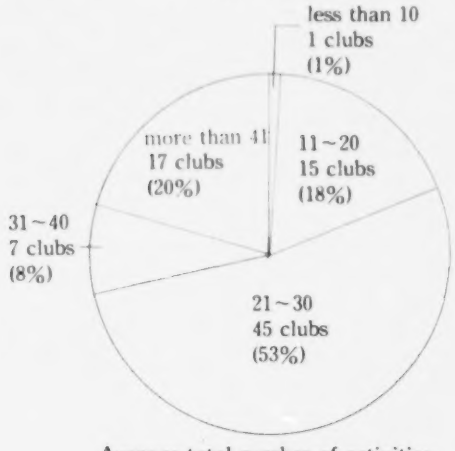
The Prize of the Director General of the Japanese Patent Office	Bar-Chart/Pie Chart Converter (P4 Boy)	Easy Nail Box (P4 Boy)	The Hare and the Tortoise (P2 Girl)	Constellation of Four Seasons (P6 Girl)
The Prize of the President of JIII	Expandable/Contractable Trash Box (P3 Boy)	Improved Birdcage from which a Bird cannot Escape (P6 Boys)	My Marionette (P4 Boy)	Device for Forming Both-sided Adhesive Tape (P6 Boy)
	Spotbilled Duck Family (P5 Boy)	Scale for Blackboard (M2, 3 Boys)	Stereoscopic Constellation Box (M3 Boy)	Beach Parasol with Fastener (M1 Girl)
	Shoulder Bag/Hand Bag/Knap Sack (M1 Girl)	Drain Pump for Play Ground (H3 Boys)	Terrestrial Magnetism Meter (H3 Boy)	Device for Demonstration Kirchhoff's Law (H2 Boys)
The Prize of the President of the Patent Attornay's Association of Japan	Rotatable Handkerchief Dryer (P4 Girl)	Pencil Stand Having an Elevator-like Function (P1 Boy)	Canvas Shoes which cannot be worn like Slippers (P1 Girl)	Dolphine Exhibition (P3 Girl)
The Mainichi Shimbun Prize	Card-type Bookstand with Textbook Reminder (P5 Boy)	Percussion Instrument Formed of Bamboo, Wood, and Metal (P2 Boy)	Ball-Recovering Device (M2 Boy)	Yawing Crocodile (P2 Boy)
The Prize of the Mainichi Jr. High School Students Newspaper	Ball Collector for Table-Tennis (M1 Girl)	Information Panel Using Glass Beads (M2 Boy)	Nesting Box which can be Attached anywhere (M1 Girl)	Angle Measuring Instrument with Stopper (M1 Girl)
The Prize of the Mainichi Primary School Children Newspaper	Soap Bubble Former (P6 Boy)	Flexible Movable Dustpan (P5 Boy)	Magnetic Type Dipper Receiver (P2 Boy)	Whistle Blowing Locomotive (P4 Girl)
The Prize of the Mainichi Children Newspaper	Walking Ladybird (P2 Boy)	Toy Representing Sea Otter (P2 Boy)	Progressively Inflatable Whale (P2 Girl)	Safety Umbrella (P1 Boy)
The WIPO Prize	Air Coaster (P4 Boy)	Atlas of the World (M3 Boy)	Constellation Model Formed with Optical Fibers (M1 Boy)	Automatic Water Sprinkler (M3 Boy)



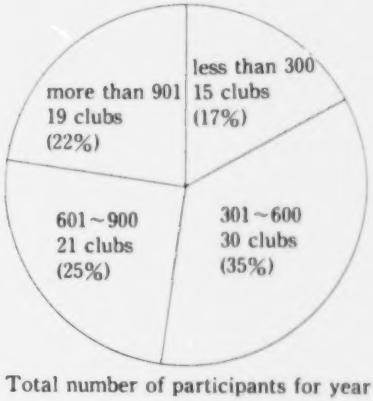
Participants per one club



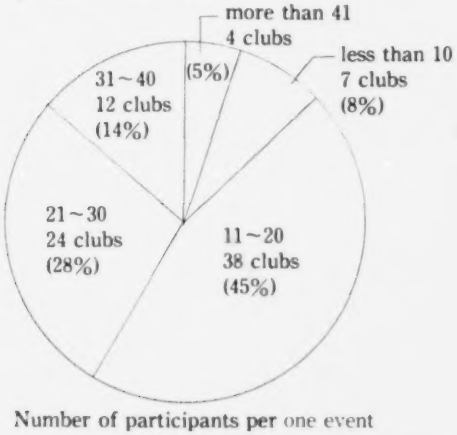
Number of advisors per one club



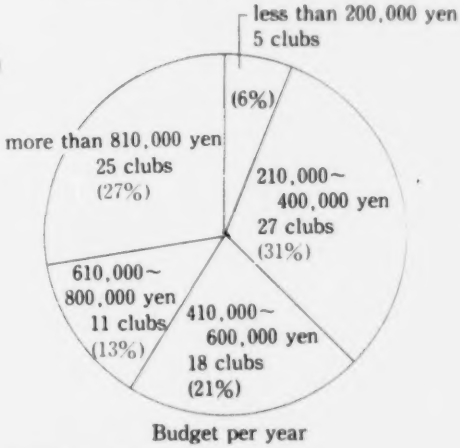
Average total number of activities per year in one club



Total number of participants for year



Number of participants per one event



Budget per year

Fig. 4 "Statistics for Invention Clubs"

III. Invention Club for Boys and Girls

The activities for promoting children's creativity are carried out at the local Invention Club for Boys and Girls. The first Invention Club for Boys and Girls was opened in 1974, to foster the potential creativity originally possessed by the youngsters, to stimulate their imagination, and to develop a scientific idea. The largest one is the Kariya Invention Club for Boys situated in the Toyota Science Research Institute, Kariya City, which has 1500 members. The smallest one has only 20 members.

As of 1989, there are 101 Invention Clubs for Boys and Girls all over Japan. The local Invention Clubs are provided with subsidies by the Japan Institute of Invention and Innovation and the local Board of Education. Clubs are usually situated in primary schools, local cultural centers, local science centers, local museums and so on. In addition to students, each club has several members who act as advisors or leaders. Most of them are school teachers, retired school teachers, advisory teachers belonging to the local Board of Education, or engineers and technicians in industries. A variety of people with varying backgrounds and different experiences in science and technology fields support the local clubs.

Boys and girls mostly from the third or fourth grade in primary school to the second grade in middle school gather together at the clubs during holidays and after school hours.

Figure 4 shows the statistics for the activities of 85 clubs in 1986. The average number of participants was 63, that for advisors was 10, and that of opening days per year was 36. The average total number of participants was 804 and that of participants in some opening days was 24. The average budget was 1,310,000 yen per year. In the clubs the participants are to practice to produce a variety of handicraft. Before starting their creative activity, they are to exercise "Brainstorming" to develop their idea into a scientific conception.

These activities should affect the development of children's creativity.

IV. Further Aspects

In order to promote children's creative activities, the follow-up research on children who were awarded prizes is needed. For example, their psychological, social and environmental conditions, their activities in schools and families, their inventive thinking process, and other aspects are main objectives for analysis.

After these studies had been carried out educational training systems for cultivating children's creativity could be developped and their effects would be evaluated by the increase in the number of prizes to be awarded to trained children and to those benefiting from improved conditions.

ACKNOWLEDGEMENT:
The author is the chairman of the Selection Committee of the Contests on School Children's Inventions and expresses his gratitude to the staff of the Japan Institute of Invention and Innovation.
Keywords: Invention, Creativity, School Children

An Evaluation of the T.H.E. CAI System Based on Students' Opinions

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Summary: TheT.H.E. system(Terada and Hirose Education system) is a multi-media CAI system with a video disc player controlled by a personal computer. This system was first presented in 1981, and has been improved several times. Therefore, it is necessary to evaluate the latest T.H.E. system from the relationship between system features and learning effects. First, our latest T.H.E. CAI system is presented briefly. Second, an SS analysis(Semantic Structure analysis) that is used for evaluating our system is introduced. Third, an evaluation of our system is discussed via an SS analysis and a factor analysis. As a result, the effectiveness of deterministic solution, called 'TESSOKU', was shown.

1. INTRODUCTION

The T.H.E. System(Terada and Hirose Education system) is a multi-media CAI System with a video disc player controlled by a personal computer. The T.H.E. prototype system was presented in 1981 [1]. In comparison with the prototype system presented at first, the latest system has been made much better according to the development of electric media and computer technology. Especially, the T.H.E. system has many effective features as a CAI system, e.g. voice presentation through the SWSD (Still With Sound and Data) method. Already, on the usage effects, it has been reported that students who studied using the T.H.E. system performed better than they did before using it [2].

The aim of this report is to analyze the relationship between system features and learning effects. In order to analyze this relationship, a Semantic Structure (SS) analysis [3] as an analysis method for a graphic representation of questionnaire items is presented. First, this paper presents an outline of the latest T.H.E. system. Second, for this purpose the SS analysis method and the factor analysis method are introduced. Third, in order to evaluate the relationdhip, the results of students' opinions are treated by using these analysis methods. Last, the results of these analyses are discussed.

2. THE T.H.E. SYSTEM

An outline of the T.H.E. system, i.e. hardware, courseware and features, is presented.

(1) HARDWARE

The latest hardware configuration of the T.H.E. system is a personal computer connected to a